MARKETING GRAIN SORGHUM IN KANSAS

by

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INTRODUCTION

Historical Background

The sorghums, once natives of Africa and Asia, are noted for their drought resistance. They make a comparatively better growth than corn in dry years, and their feeding value for livestock is about equal to that of shelled corn.

Most kafirs and sargos were introduced into the United States from British South Africa. The arrival of the sargo group is estimated to have been about 100 years ago. Brown and white durra introduced into California in 1874 from Mediterranean Africa, commonly known as "Egyptian Corn," were among the first to become established in this country, and these varieties are still grown in limited quantities.[1]

In 1876, two varieties of kafir came to the United States from South Africa. Plant breeding work was carried on in Georgia and distribution of seed of these varieties was first made in 1885 and 1886.

Yellow milo was another sorghum that came into prominance in about 1885, and it was distributed and grown in the drier parts of Texas, Kansas, and other Southwestern States.

A. F. Swanson and H. H. Laude in Kansas Agricultural Experiment Station Bulletin 349 remark that, "Milo, like kafir,

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[1] Carleton R. Ball, The History and Distribution of Sorghum, United States Department of Agriculture Bureau of Plant Industry Bul. No. 175, pp. 48-49.

was at one time widely distributed in southwestern Kansas. After 1935 these varieties declined rapidly in the Plains region and have been replaced almost wholly by the new combine types."[1]

Grain sorghum production is now centered in the states of Texas, Kansas, and Oklahoma. These three states produced 83 percent of the 1953 and 1954 production. Texas alone produced about 50 percent of these crops. Kansas ranked second with an average production of 37,839,000 bushels for these two years, or an average of 24 percent of the grain sorghum produced in the United States.

Purpose and Problem

Kansas farmers have not obtained maximum return from their sorghum grain production. It is believed that more complete knowledge on marketing of the commodity can lead to improvements. In this study emphasis is given to those prices of sorghum grain and to those marketing practices important in influencing entrepreneural decisions involved in the marketing of the crop.

There is considerable parallelism in the marketing of farm products that have similar characteristics. For the most part, grain marketing facilities in Kansas have been developed chiefly to move wheat from farm to market. Although the production of

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[1] A. F. Swanson and H. H. Laude, Grain and Forage Sorghums for Kansas, Kansas Agricultural Experiment Station Bulletin 349, pp. 10-11.

sorghum grain is not as important as that of wheat in Kansas, if viewed from the quantity of grain produced, it is important from the standpoint that it is an alternative crop adapted in the state and, for the present at least, has no physical surplus problem. Therefore, grain sorghum is likely to be grown on many of the acres diverted from wheat production by acreage allotments. To the extent that inefficiencies exist in the marketing system, or knowledge of the market is lacking, the incomes of those farmers who produce the grain, and of those persons who handle and utilize the grain are affected.

Procedure

Marketing practices and sorghum grain movements were analyzed by both the commodity and functional approach of market analysis. Factors that cause or explain variation of prices in time and between commodities have been studied by statistical measures.

Historical data available in the annual Reports of the Kansas State Board of Agriculture published by the State Board of Agriculture, Agricultural Statistics, The Feed Situation, and Crops and Markets, monthly or bimonthly reports of the United States Department of Agriculture were utilized extensively in this study.

The procedure or methods used for a particular section is specified in the text, so as to provide better continuity in this study.

Limitations

No assurance can be given that herein described past price relationships, price movements, or marketing practices projected into the future will occur again. However, certain price patterns have tended to repeat over time which gives a basis for anticipating future patterns. Also, this study is specifically limited to certain aspects of marketing of grain sorghum inasmuch as the problem is complex.

REVIEW OF LITERATURE

General

There is a growing body of literature concerned with the economics of substituting various feed and feed grains in livestock rations. Sorghum grain is described as substituting at an equal value or at an almost equal value with corn in these studies. There is also available a large amount of published material dealing with the agronomy of grain sorghums and with their products and uses. Publications listed in the reference section were found to be useful sources of information and ideas, although not all have been quoted in this study.

A comprehensive study of the major economic forces affecting the demand and price of oats, barley, and sorghum grain in the United States was published in September 1953. Until that time, there were apparently no published studies concerned with analyzing the prices of sorghum grains. This study, by

Kenneth W. Meiken, Agricultural Economic Statistician, United States Department of Agriculture, undertook to describe the economic relationships that existed within the feed-livestock economy and the supply-demand forces that affect the different concentrates.[1]

Factors That Cause Deviations of Sorghum Grain Prices from Prices of Corn

According to Meiken, the principal variable that influences the year to year variations in the relationship of sorghum grain prices to prices of corn from November to May is relative supplies, as 69 percent of the year to year variation in prices was explained by production of sorghum grains relative to the supply of corn. The addition of two other variables, animal units fed in Texas, Kansas, and Oklahoma, and production of corn in these states relative to the United States production of corn helped the analysis and the three together explained 79 percent of the variation in relative prices for the years 1932 to 1942.[2]

Elasticity of Substitution of Grain Sorghum for Corn

Mr. Meiken's analysis disclosed that sorghum grain may be substituted more readily for corn than barley and oats. This

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[1] Kenneth W. Meiken, The Demand and Price Structure for Oats, Barley, and Sorghum Grains, U. S. Department of Agriculture Technical Bulletin No. 1080, pp. 1-101.

[2] Ibid., p. 60.

is in line with the relative feeding values of the three feed grains as compared with corn.[1]

Price Differentials Because of Grades

Meiken found that "Moisture content is the principal factor associated with prices for the different grades of sorghum grains. However, other grade factors such as test weight per bushel, spoilage, and foreign material are also considered."[2] His comparison was based on Kansas City prices, 1946 to 1950. The premium paid for No. 1 milo was not quite as high as would be expected solely on the basis of dry-matter content. Therefore, the other factors of quality seem to be important in determining the price of the No. 1 grade.[3]

Sorghum Grain as Feed

Professor Frank B. Morrison in the book Feeds and Feeding, 21st Edition, 1949, writes, "The grain sorghums resemble corn grain in composition and feeding value. Like corn, they contain about 70 percent nitrogen-free extract, which is nearly all starch, and they are low in fiber and rich in total digestable nutrients. Most of the grain sorghums have somewhat more protein than does corn, but they have considerably less fat."[4]

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[1] Ibid., p. 64.
[2] Ibid., p. 89.
[3] Ibid., p. 97.
[4] Frank B. Morrison, Feeds and Feeding, 21st Edition, p. 523.

Professor Morrison further indicates grain sorghums give good results when fed, that they are well liked by livestock, but the seeds of darso, shrock and sagrain, which are hybrids between grain sorghums and sweet sorghums are somewhat bitter, due to a high content of tannin and are less palatable than corn.[1]

Ground grain sorghum is about equal to corn on a pound per pound basis when fed to dairy cattle and sheep and it has proven to worth about 90 percent the value of corn in feeding to swine and beef cattle.[2] Recent swine feeding experiments at Kansas State College indicate in some cases that grain sorghums are superior to corn in feeding value.[3] Test results published in Kansas Agricultural Experiment Station Circular 287, Swine Feeding Investigations 1946 to 1949, indicate differences exist in feeding values between varieties of grain sorghum.[4]

Storage of Sorghum Grain

According to Mr. C. K. Shedd, Agricultural Engineer, Bureau of Plant Industry, Soils and Agricultural Engineering and Mr. H. H. Walkden, Entomologist, Bureau of Entomology and Plant

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1 Loc. cit.

2 Leonard W. Schruben and Clifton, R. E., Grain Substitution in Feeding Livestock, Kansas Agricultural Experiment Station Circular 299, Table 2.

3 41st Annual Livestock Feeders Day, Circular 308, Kansas Agricultural Experiment Station, pp. 54-55.

4 C. E. Aubel, Swine Feeding Investigations, 1946-1949, Kansas Agricultural Experiment Station Circular 287, pp. 18-20.

Quarantine, Agricultural Research Administration, "Farmers generally have experienced more storage difficulty with threshed grain sorghums than with any other grain crop except corn. Problems arise from a number of factors, including the nature of the crop itself and the climatic conditions in the main areas of production."[1]

The stalks of the grain sorghum plant may contain up to 60 percent moisture when the grain is mature. This is in contrast with wheat and other small grains, where the plant is dry when the grain is mature. This difference is an important factor as foreign material in combined grain sorghum is likely to contain a high percentage of moisture and will increase the hazards of deterioration or spoilage during storage.[2]

Weather conditions in the fall when grain sorghum matures are often not favorable for field drying the crop, so that even with good management in harvesting and threshing; it is sometimes impossible to deliver grain from the combine at a moisture content low enough for safe long time storage.[3]

In Kansas, the climate is warm enough to make conditions favorable for the activity of insects in stored grain, making long time storage of sorghum grain an important problem.[4]

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[1] C. K. Shedd and H. H. Walkden, Grain Sorghum Storage, U. S. Department of Agriculture Circular No. 760, p. 3.

[2] Loc. cit.

[3] Loc. cit.

[4] Loc. cit.

Tests at the Fort Hays Branch Experiment Station and at the Commodity Credit Corporation bin site at Hutchinson, carried on as a cooperative study from 1939 to 1947 by the Agricultural Research Administration and the Production and Marketing Administration of the Kansas Agricultural Experiment Station, indicated that the maximum moisture content of grain sorghum for safe year-round storage in a tight bin is about 13 percent under Kansas conditions. Grain with 20 percent moisture became hot within one week after being binned in the latter part of November. Grain with 15 percent moisture, binned late in fall or early in winter, was free from visible damage until a period ranging from April to June.[1]

In Texas, tests conducted to determine the practicability of storing sorghum grains on South Texas farms, indicate that the moisture content of the grain and the amount of foreign material (trash) in the grain are the main problems encountered. It has been found that all of the grain stored in any one bin should be reduced to a moisture content of 12 percent or less for safe storage. This 12 percent is maximum for the wettest grain in the bin. Foreign material in excessive amounts may cause heating even if the moisture content of the grain is below 12 percent, as the stems and leaves contain a higher percentage of moisture than the grain at harvest time.[2]

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[1] Ibid., p. 31.

[2] J. W. Sorrenson, Jr., and others, Drying and Storing Sorghum Grain in Farm Storage Bins in South Texas, Texas Agricultural Experiment Station Progress Report 1685, pp. 1-7.

The control of insect activity in sorghum grain stored on the farm requires a heavier dosage of fumigant than does wheat. The recommended dosage is about twice that recommended for wheat and heavier dosages are required in wooden bins as compared with steel bins. Amount required depends on the fumigant used.[1]

Utilization of Sorghum Grain Marketed

In the United States, the bulk of sorghum grains entering commercial channels is purchased for livestock feed or exported. About 40 percent of the quantity marketed by farmers was bought for feed and about 45 percent was exported during 1947 to 1951. Substantial quantities of the sorghum grains have been used to produce alcohol during the Second World War and in some years since. A wet-processing plant in Corpus Christi, Texas, has been in operation since 1949 and it has a capacity of about 6 million bushels annually.[2]

Exports have been an important outlet for sorghum grains. The Texas crop is favorably located for export, and the bulk of the exports are shipped from Galveston.[3] The heavy producing area in the Southwest, particularly along the Gulf Coast, is favored by transportation advantages in reaching important

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[1] Control of Stored Grain Insects in the North Central States, University of Minnesota Agricultural Experiment Station Bulletin 425, North Central Regional Publication No. 49, p. 14.

[2] Marketing, Yearbook of Agriculture, 1954, pp. 412-413.

[3] Ibid., p. 413.

domestic and foreign seaboard markets, as compared with corn from the central Corn Belt.[1]

Annual United States exports of sorghum grain, from 1944 to 1953, averaged 28,108,500 bushels; corn exports averaged 80,568,700 bushels. Grain sorghum made up an average of 25.9 percent of the corn and grain sorghum exported during this period. Prior to 1944, only small amounts of grain sorghum were exported.

Domestic uses of grain sorghum, until recently regarded as a feed crop, could expand to an important industrial source of raw material.

PRODUCTION AND MARKETING IN KANSAS

Grain Sorghum Production

In Kansas, the raising of grain sorghum has not been as important as that of wheat production, but it has been approximately equal to corn production. It is important from the standpoint of its ability to resist drought and its being adapted to the western two-thirds of the state where it has a comparative advantage over corn.

A former drawback of raising grain sorghums was that they did not lend themselves to mechanization. Now, however, American plant breeders have literally tailored the crop to fit the

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[1] Crops in Peace and War, Yearbook of Agriculture, 1950-51, p. 349.

machine, and they are as easily harvested with the combine as wheat.

Grain sorghum production has been greatest in the western two-thirds of the state as is shown in Fig. 1 and Table 1. Total production by crop reporting district has varied from year to year, depending upon acreage, weather and moisture conditions. The proportion produced by each district within the state has been quite variable as shown by the percentage distribution indicated in Table 1. The average production in Kansas for 1949-1953 was 34,997,200 bushels. For this same period, 30 percent of production was concentrated in southwestern Kansas, crop reporting district 7; production of about 52 percent of Kansas grain sorghum was in the western one-third of the state, with only about 13 percent in the eastern third.

As shown in Fig. 2, Kansas production has tended to increase in the last 25 years, as has United States production. It was noted that production has tended to increase more than harvested acres in Kansas and in the United States, which indicates a tendency for higher average yields. Fig. 2 was plotted on log scale to make percentage changes apparent and clearly indicates a greater degree of variability in Kansas production as compared with total United States production. Drought and unfavorable growing conditions in the state of Kansas in the 1930's are reflected in the production figures while harvested acres remained relatively stable. Variability in acreages harvested is largely due to weather and moisture

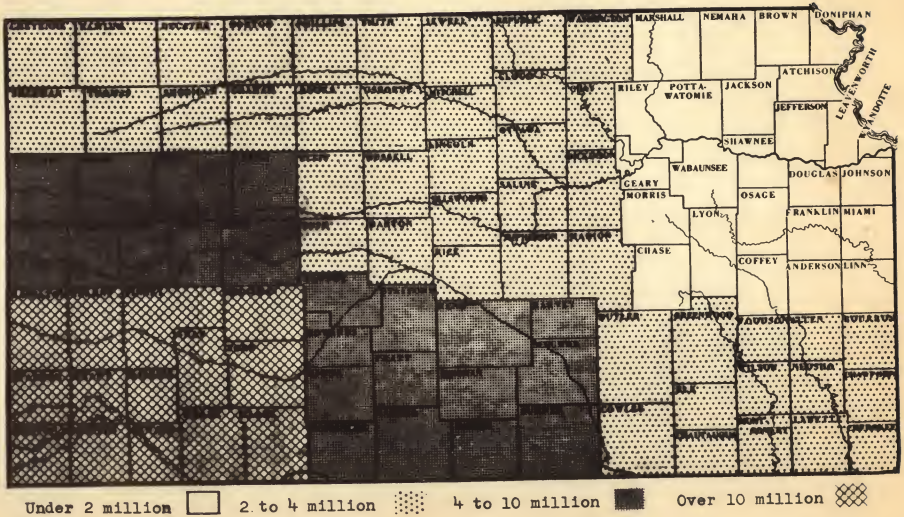

Fig. 1. Sorghum grain: Average bushels produced by crop reporting districts, Kansas, 1949-1953.

Table 1. Sorghum Grain: Production in Kansas, average 1949-1953 and annual 1951, 1952, and 1953.

Crop reporting district	Production				Percentage distribution			
	Average 1949-53 (bushels)	1951	1952	1953	Average 1949-53 (percent)	1951	1952	1953
1	2,391,722	3,723,510	1,290,400	2,867,800	6.8	6.5	7.0	9.0
2	2,776,206	2,211,130	2,354,500	2,661,300	7.9	3.9	12.7	8.7
3	586,590	191,250	512,500	941,900	1.7	.3	2.8	3.2
4	5,524,200	12,803,040	1,410,800	4,340,900	15.8	22.4	7.6	14.3
5	3,699,976	4,346,820	2,491,200	4,331,100	10.6	7.6	13.4	14.2
6	1,780,314	825,380	1,745,400	2,452,500	5.1	1.4	9.5	8.0
7	10,515,524	23,711,270	4,050,700	4,872,000	30.0	41.4	21.8	15.9
8	5,478,236	7,534,020	3,083,700	5,771,600	15.7	13.1	16.6	18.8
9	2,243,032	1,963,580	1,596,800	2,400,900	6.4	3.4	8.6	7.9
Total	34,997,200	57,310,000	18,536,000	30,640,000	100.0	100.0	100.0	100.0

Source: Federal-State Crop Reporting Service

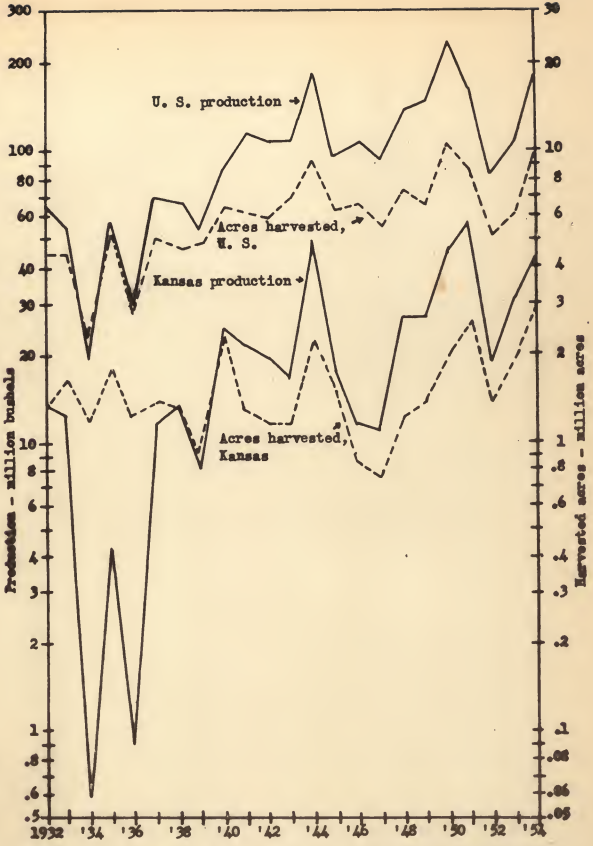

Fig. 2. Sorghum grain: Production and acres harvested, United States and Kansas, 1932-1954.

conditions. In Kansas many farmers have grown grain sorghum as a catch crop; if wheat was abandoned or if conditions in the preceding fall were unfavorable, grain sorghums could be planted, if moisture was received in the spring.

W. M. Ross and John D. Miller, Associate Agronomist, Field Crops Research Branch, A. R. S., USDA, and Assistant Professor, Kansas Agricultural Experiment Station, respectively, report, "Considerable emphasis is being placed on development of sorghum hybrids at the Hays station. A practical method of hybrid production should be available to farmers in a few years. Advantages of hybrid sorghum should parallel those of hybrid corn."[1]

Grain sorghum hybrids should cause total production of sorghum grain to increase in the state due to increasing yields. However, the effect on Kansas production in relation to her standing with other states is uncertain. Hybrids will tend to increase the comparative advantage of areas of high yields relative to areas of low yields. A 20 percent yield increase, for example, will mean 72 bushels per acre in a former 60 bushels per acre area, but only 18 bushels per acre in a former 15 bushels per acre area. It can be further reasoned that the grain sorghums are likely to be grown in a larger area in the United States when hybrids are perfected.

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[1] Fall Field Day Report of the Hays Branch Station, Hays, Kansas, for 1954-55, Circular 330, Kansas Agricultural Experiment Station, p. 7.

Grain Sorghum Sales a Function of Production

The quantity of Kansas sorghum grain sold each year from farms where grown has varied directly with the size of the year's production as shown in Fig. 3.

The linear trend line, $Y = 9.071,720 + 0.69815\ (X-19,178,880)$, expresses the function. The coefficient of correlation $r = 0.968$ indicates a positive relationship and is highly significant.

For the 25 year period 1929 to 1953 inclusive, the average quantity of sorghum grain sold from farms where grown was 9.071,720 bushels, compared with the average production for the period of 19,178,880 bushels or an average of about 47 percent sold. The average sold for the period of 1949 through 1953 crops was 63.8 percent of production, average production being 36,220,600 bushels and average sold from farms where grown 23,142,000 bushels for this period. A large crop has not only resulted in a larger absolute quantity of sorghum grain marketed, but has also resulted in a percentage increase of the portion of production sold from farms where grown. This indicates a relatively fixed utilization figure on grain sorghum producing farms, which has not increased proportionally with size of crop.

Distribution of Sales Throughout the Year

Although in large crop years a larger amount of grain has been marketed, this apparently has had little effect on the

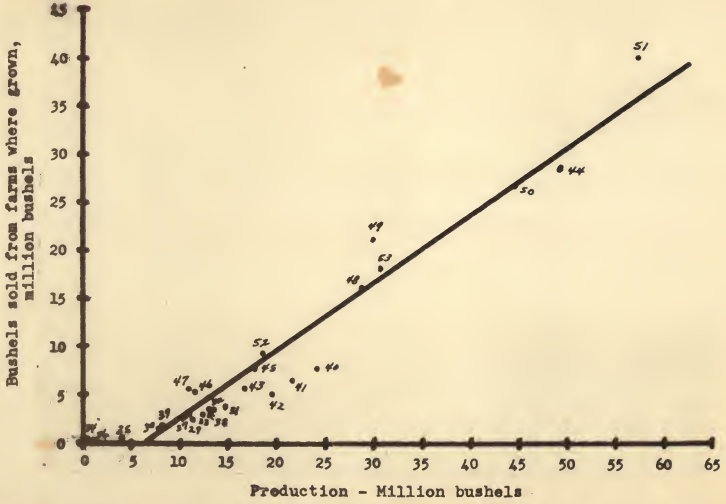

Fig. 3. Sorghum grain: Production and bushels sold from farms where grown, Kansas, crop years, 1929-1953.

percentage of sales that occurred in any one month. This stability indicates that marketing channels have been fairly adequate to handle the sorghum grain marketed, at least for the size of crops encountered so far in this state. The data further indicates that much of the grain sorghum produced was marketed immediately following harvest.

The distribution of grain sorghum sales by Kansas farmers is given in Table 2. The sale of sorghum grain by farmers was largely concentrated in a four month period; October, November December, and January, following the harvest. For the period 1939 to 1951, sales during these months averaged about 65 percent of the crop sold during the year. In November alone, an average of 25 percent of the crop sold was marketed.

For purposes of comparison, during the period 1930 to 1939, an average of about 48 percent was marketed during the peak months, with December having the heaviest marketings, with an average of 16 percent of the crop sales being made during this month. The change in the monthly marketing pattern illustrates an effect of combine harvesting and of the development of earlier maturing varieties, as a more even distribution of annual sales by months existed prior to 1937 and 1938 when topping and threshing were still prevalent methods of harvesting the grain.

As mentioned previously, combine type grain sorghums have gradually increased in importance after 1935, and this change has undoubtedly effected the monthly pattern of marketing.

Table 2. Sorghum grain: Estimated monthly sales by Kansas farmers, 1930-1951.

Crop year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
	(Estimated percent of sales occurring monthly)											
1930-31	5	11	15	13	10	10	8	7	9	5	4	3
1931-32	5	11	15	13	10	10	8	7	9	5	4	3
1932-33	5	11	15	13	10	10	8	7	9	5	4	3
1933-34	5	11	15	13	10	10	8	7	9	5	4	3
1934-35	5	11	15	13	10	10	8	7	9	5	4	3
1935-36	6	9	11	10	8	8	9	8	9	10	8	4
1936-37	6	17	15	12	10	8	6	6	6	6	5	3
1937-38	6	24	20	15	12	8	4	3	2	2	2	2
1938-39	9	20	25	10	6	5	7	6	5	3	2	2
1939-40	16	20	20	10	6	6	6	6	4	2	2	2
1940-41	13	19	15	10	10	8	7	7	5	2	2	2
1941-42	5	20	20	14	10	7	8	7	4	2	2	1
1942-43	4	18	10	10	11	12	6	4	8	7	4	6
1943-44	21	33	12	7	8	2	3	4	3	1	1	5
1944-45	5	15	16	15	9	9	9	10	9	1	1	1
1945-46	20	50	14	5	3	2	1	1	1	1	1	1
1946-47	14	23	16	11	10	5	7	6	4	1	1	2
1947-48	10	26	25	10	3	3	5	5	9	1	1	2
1948-49	18	23	14	8	10	7	8	5	2	2	1	2
1949-50	9	30	18	15	8	8	4	3	2	1	1	1
1950-51	10	27	18	12	9	6	3	4	4	2	3	2
Average												
1930-39	5.8	13.9	16.2	12.4	9.6	8.8	7.3	6.4	7.4	5.1	5.4	2.9
1939-51	12.1	25.3	16.5	10.6	8.1	6.3	5.6	5.2	4.6	1.9	1.7	2.2

Source: Kansas State Board of Agriculture.

This pattern of marketing reflects the following tendencies in Kansas; (1) very little grain sorghum goes into farm storage, (2) grain sorghum has been produced largely as a cash crop, (3) utilization as a feed grain on farms where grown has not expanded in proportion with increases in production.

Data giving stocks on farms in Kansas as of January 1 and October 1 was available for the years 1950 through 1953. For this period stocks on farms in Kansas as of January 1 averaged 18,720,000 bushels; stocks as of October 1 averaged only 2,146,000 bushels. During the same period stocks off farms in Kansas on January 1 averaged 14,789,250 bushels, on April 1, 11,575,000 bushels and on October 1, 3,785,750 bushels. These figures illustrate the tendency for the large portion of grain sorghum sold from farms where grown to leave the farm soon after harvest. Also shown was a fairly uniform disappearance of off farm stocks by quarter. Sorghum grain has not yet been produced in sufficient quantity to have a surplus problem. Also it has usually been priced low relative to corn in Kansas. Because of its ability to substitute for corn, as feed, if this type of pricing arrangement continues to exist, there will probably continue to be only small carry-over from year to year.

Marketing Through Country Elevators

Method of Procedure and Definitions. During the summer of 1955, Kansas State College participated in a North Central Region

Cooperative Research Project on country elevator marketing operations. Information on marketing of grains by country elevators was obtained from country elevator managers. A sample was drawn from the population of all known country elevators operating in the state. The definition of a country elevator includes all local buyers of grain who purchase grain directly from farmers for the primary purpose of introducing it into the marketing channels, including local sales as well as out-of-town sales and shipments.

Information for the questionnaire was obtained by personal interview with the managers of country elevators selected by the sampling procedure. The population of country elevators was stratified by crop reporting district. A 10 percent sample of the country elevators in each crop reporting district was selected at random so that all elevators in the district had an equal chance of falling into the sample. The elevators in each crop reporting district were arranged alphabetically by town, numbered consecutively, and then the sample was picked from a table of random numbers. A total of 144 elevators were included in the state sample. The number of elevators, by crop reporting district, ranged from 10 in District 1 to 31 in District 8.

Generalizations made in this section are based on the assumption that the sample is representative of the crop reporting district and the data is expanded on that basis. Part of the information obtained pertaining to the marketing of sorghum grain by country elevators is summarized below.

The Western One-Third of the State. The western one-third of Kansas has been a surplus production area of grain sorghums. In this area, country elevators have sometimes handled as much grain sorghum as wheat.

In the northwestern section of western Kansas, an estimated three-fourths of the grain sorghum marketed has been composed of distance sales, with local sales to farmers in this area relatively small, reflecting a light local demand. The bulk of distance sales, an estimated 65 percent, was moved by truck to northeastern Colorado, northeastern Kansas, and a small amount to Texas and Oklahoma. Rail shipments from northwestern Kansas were made mostly to Kansas City, with small amounts going to Denver, Colorado.

Truck merchants, or truckers who buy and transport the grain for resale, have been important in moving sorghum grain from this area. The country elevator managers for the most part preferred truck shipments for convenience, and they indicated that they were usually able to obtain a better price for their grain from truckers. The main problem with truck sales was some lack of faith in the checks obtained from truckers in payment for the grain.

In the west central area of Kansas, crop reporting district 4, local sales have been slight, practically all of the country elevator receipts being moved from this area. Rail shipments moved about 80 percent of the grain sorghum receipts of country elevators to Hutchinson, Salina, Denver, Kansas City, and Wichita,

and small amounts to Ellis and Hays, Kansas. Trucks transported grain to Denver and eastern Colorado and some to southeastern Kansas, but rail shipments were dominant.

The southwestern corner of Kansas, crop reporting district 7, has been the main surplus producing grain sorghum area in the state. Country elevator managers reported only small quantities resold locally, with heavy receipts from farmers in this area. Almost one-half of the grain was moved by truck to northeastern Colorado, eastern Kansas, Oklahoma and Texas. The rail shipments were mostly consigned to Hutchinson, with sizeable quantities to Dodge City and some to Wichita, Denver, and points in California.

Central Kansas. Central Kansas, composed of crop reporting districts 2, 5, and 8, has been a moderate grain sorghum production area.

Of the total receipts of country elevators in this area, about one-half was resold locally to farmers. Some elevators purchased small amounts of grain sorghum from truckers coming from western Kansas to satisfy local requirements.

The north central district has been a fairly heavy production area, with a little less than one-half of elevator receipts resold locally to farmers. The balance of the receipts was shipped largely by rail to Kansas City, Topeka, Atchison, and Salina, Kansas, St. Joseph, Missouri, and Omaha and Hasting, Nebraska. Sales to truck merchants were destined largely to central and southeastern Kansas.

Elevators in central Kansas, crop reporting district 5, have had moderate grain sorghum receipts from local farmers, but some shipped in grain from western and north central Kansas and Nebraska, to satisfy local demands. Grain shipped by country elevators remained in close proximity of the area, some being shipped to terminals in Salina, Wichita, Hutchinson and Abilene for storage.

Country elevator managers in south central Kansas indicated that more than half of their grain sorghum receipts were resold locally. Some grain sorghum was purchased from southwestern or western Kansas, and a small portion from Oklahoma and Texas, for resale locally. Truck shipments, via truck merchants, moved on to eastern Kansas, Missouri and Arkansas from this area. Most rail shipments from this area were consigned to Hutchinson and Wichita.

Eastern Kansas. The eastern one-third of Kansas has produced less sorghum grain than either of the other two divisions. This has been due to the relatively small quantity produced in northeastern and east central Kansas. Grain sorghum is a fairly important crop in southeastern Kansas. The country elevator managers in the eastern one-third of Kansas have tended to sell a large portion of local receipts locally and some shipped in sizeable quantities for resale locally.

Crop reporting district 3, northeastern Kansas, has been the minor producer of grain sorghum, as corn has been grown in this area to a greater extent than anywhere else in the state.

Country elevators purchased grain sorghum locally and shipped in some from western Kansas by truck. Approximately 50 percent of the country elevator receipts in this area were reported to have been resold locally to farmers for feed. Rail shipments to Kansas City and some to Topeka for storage and truck shipments to southern Oklahoma accounted for the balance of receipts.

In east central Kansas, about 80 percent of the local receipts were sold back to farmers. Truck receipts from western and north central Kansas and Texas, and rail receipts from northwestern Kansas were reported as additional receipts. The bulk of distance sales moved by rail to Kansas City, with some grain being moved by truck to nearby cities in central Kansas.

Southeastern Kansas country elevator managers reported that two and a half times as much grain sorghum was sold to local farmers as was locally received. The area had few distant sales of grain sorghum, with only a small quantity being moved by truck to southern Missouri and Arkansas and by rail to Kansas City from this district.

Receipts by truck from western Kansas were greater than local receipts, with truck receipts from Oklahoma and Nebraska reported by elevator managers. Rail receipts from western Kansas were only about 10 percent of truck receipts but almost 20 percent of the quantity received from local farmers.

MARKETING CONSIDERATIONS

An important question arises in consideration of when to market sorghum grain. Will the price rise enough from harvest to the time of sale to cover the costs of holding the grain? For any future period, this question can never be answered with certainty. However, an inquiry into what has happened in the past is possible, and it is one of the best available indicators.

Costs of Storage on the Farm

A producer, in determining whether or not to store a sorghum grain crop that is in condition for storage, must consider costs of storing on the farm.[1] Although these costs will be different on most farms, a guide is necessary when considering the profitability of storage, as there is no advantage in holding grain in storage following harvest if the price rise expected will not cover or exceed storage costs. If prices decline during the storage period, storage costs add to the loss.

A producer with storage facilities already constructed will have incurred fixed costs which will continue whether the

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[1] Drying sorghum grain with excess moisture content is possible, however, present methods are expensive especially if grain is very moist and facilities are not widespread for artificial drying of large quantities in rural areas. Field drying is probably most practical under normal weather conditions.

facility is used or not; therefore, variable costs are the prime consideration to a producer in this situation.

Professor John H. McCoy of the Kansas Agricultural Experiment Station determined cost of storing wheat on farms by budget analysis for 1951.[1] In the study, prior to actual budgeting of costs, decisions were necessary in determining type of construction, size of storage unit and degree of utilization. Since the original investment per bushel of storage capacity for wooden bins was found to be substantially greater than for steel bins, consideration of construction of wood bins was not covered in the cost estimates for long run policy. Steel farm storage units of various volumes were selected on the basis of a determination of the most prevelant quantity of wheat placed under support programs on Kansas wheat farms and observed trends in type of construction. These six different volumes were used:

(a) 1,000 bushels (round bin)

(b) 2,200 bushels (round bin)

(c) 3,276 bushels (round bin)

(d) 6,552 bushels (two 3,276 bushel bins)

(e) 13,104 (four 3,276 bushel bins)

(f) 25,000 bushels (flat storage type)

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[1] John H. McCoy, Grain Storage Policy with Particular Reference to Cost of Storing Wheat in Kansas, Unpublished Doctor of Philosophy Thesis, University of Wisconsin, 1955, pp. 130-167.

The analysis of costs of storing a bushel of wheat disclosed that costs varied with size of bin and degree of utilization.

Grain sorghum prices are usually quoted as price per hundredweight. The estimated cost of storing one hundred pounds of sorghum grain for the various sizes and degrees of utilization of steel bins is given in Table 3. Interest on the value of the grain stored is not included as a cost of storage.

The estimated costs of storing sorghum grain were calculated from Professor McCoy's findings on wheat farm storage costs for 1951 on the basis that costs are equal to wheat pound for pound. Sorghum grain is considered more difficult to store by many farmers, however, if in condition to store, the costs would probably be quite similar to that of storing wheat.

In drawing conclusions regarding the absolute magnitude of costs, the influence of price level on costs is important. Relative prices of the various items of expense are subject to change over time; the index of prices paid by farmers is an available indicator of the probable direction in which these costs will vary. Comparing the 1951 United States index of prices paid by farmers for building materials with the 1953 index, construction costs in 1953 would have decreased by about 1 percent. Although these are the best cost of storage figures available at this time, the relative change in prices of the various items of expense has not been accounted for by this method and points to a need for revision if these estimates are to be applied to other conditions or time.

Table 3. Summary of estimated average annual storage cost by size and degree of utilization, farm bins, Kansas, 1951.[1]

Bin size (bushels)	Degree of utilization: 100 percent	75 percent	50 percent	25 percent
	(Total fixed cost-cents per hundredweight)			
1,000	7.56	10.08	15.13	30.27
2,200	7.97	10.62	15.92	31.85
3,276	6.53	8.70	13.05	26.11
6,552	5.77	7.70	11.53	23.08
13,104	5.38	7.18	10.78	21.57
25,000	5.18	6.90	10.36	20.71
	(Total variable costs-cents per hundredweight)			
1,000	11.85	11.88	12.05	12.93
2,200	10.78	10.93	11.10	10.77
3,276	10.53	10.63	10.93	10.30
6,552	10.53	10.53	10.53	10.92
13,104	10.25	10.22	10.53	10.53
25,000	11.18	11.08	11.02	11.03
	(Total costs-cents per hundredweight)			
1,000	19.41	21.97	27.18	43.20
2,200	18.75	22.55	27.01	42.62
3,276	17.07	19.33	23.98	36.42
6,552	16.30	18.23	22.07	34.00
13,104	15.63	17.40	21.31	32.10
25,000	16.37	17.98	21.38	31.75

[1] Computed from Professor John H. McCoy's findings on basis that costs of storing wheat and sorghum grain are equal pound per pound.

Because two treatments for insects were allowed on wheat for the long time storage program, in Professor McCoy's study, adjustment for the heavier applications recommended for grain sorghum were not made because they are about twice the dosages recommended for wheat. If the sorghum grain requires only one treatment during the storage period, these costs should be about correct. For long time storage (more than one year) the practice of regular fumigation in late August or early September should be followed.[1]

Price Trends

The price of sorghum grain in the United States during the period August 1909 to July 1914 was above corn price computed on a bushel basis. The prices of commodities during this period have been used by the United States Department of Agriculture in their computation of parity prices. Grain sorghum during this period averaged 67.76 cents per bushel and corn 64.2 cents per bushel.

An explanation of why sorghum grain prices were above corn prices in earlier years is largely explainable by considering the use to which the grain was put.

Grain sorghum was utilized to a greater extent as seed for obtaining forage; harvesting was difficult as compared with present methods, and utilization of grain sorghum as a feed grain was of less importance as compared with present times.

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[1] Shedd and Walkden, op. cit., p. 27.

The marginal utility concept offers a theoretical explanation of this price behavior, and the sacks of corn illustration by Eugen V. Böhm-Bawerk in the book The Positive Theory of Capital provide a classic example.[1] Here it is illustrated that as the quantity of a good increases in the market and the more completely can the wants to which they relate be satisfied and the less important are the wants which are last satisfied, the smaller is the marginal utility which determines the value.[2]

It is believed that sorghum grain prices in the years immediately following 1909 were influenced to a greater extent by prices of sorghum grain seed than currently. A gradual transition to utilize more grain sorghum for feed, or "less important" uses, is a factor that has been a depressing influence on sorghum grain prices, and a factor to be cognizant of in analyzing time series price data.

Seasonal Movement of Prices

Method. A thirteen month moving average of prices received by Kansas farmers for sorghum grain was computed and centered on the seventh month. The original value for each month was then expressed as a percentage of the moving average for the corresponding month. The resulting percentages were then averaged for the individual months, and this is the index of the average seasonal for that month. This method of

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[1] Eugen V. Bohm-Bawerk, The Positive Theory of Capital, pp. 149-153.

[2] Ibid., p. 152.

procedure was used to remove all elements or trends other than the seasonal from the series.[1]

An index of irregularity was computed for the 1940-1953 series, and it is represented by the shaded area in Fig. 5. This is the average deviation of the percentages of trend for a month about the value of the index of average seasonal variation for that month, and includes approximately 60 percent of the individual years included in the series. Where the band narrows or draws away from the base line, 100 on the graph, a stronger seasonal is evident. If the base line lies entirely in the shaded area, while there is an average seasonal movement present, it is less likely that it will occur in a particular year.[2]

The ratio of the range in seasonal variation in the index of irregularity was computed, as when this ratio is large, the idea of a regular seasonal movement has more validity.[3]

In general, the price data has been analyzed for the two periods, 1910-1939 and 1940-1953, in the sections that follow. This was done because the government support program for sorghum grain began in 1940 and it was felt this division would make for a more meaningful analysis.

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[1] Warren C. Waite and Rex W. Cox, Seasonal Variations of Prices and Marketings of Minnesota Agricultural Products, 1921-1935, University of Minnesota Technical Bulletin 127, pp. 3-4.

[2] Ibid., p. 4.

[3] Ibid., p. 5.

Seasonal Index of Prices Received by Kansas Farmers. For the years 1940-1953, the seasonal low price tended to be in the month of November and the seasonal high in July. The index of seasonal variation of prices received by Kansas farmers, Fig. 4, compares the seasonal movement of prices for two time periods, 1910 through 1939, and 1940 through 1953. It can be seen that the pattern has changed somewhat, as the seasonal low and the seasonal high in the index for the later period occur one month earlier than do the low and high in the 1910-1939 index. This change is similar to the changes in the monthly marketing pattern which is illustrated in Table 2. Estimated monthly sales have changed in the same direction; combine harvesting and earlier maturing varieties are believed to be the dominant influences.

The rapid decline in the index from September to November is significant to note, and although it is probably due largely to heavy marketing of the new crop, as well as the depressing influence of new corn crop marketing, it may be partially explained by lower prices being paid to farmers for high moisture grain. Grain moisture content would be a factor of greater importance soon after harvest than later in the crop year. However, a method to measure or account for this influence has not been discovered.

In Fig. 5, the 1940-1953 series is shown together with the index of irregularity. The index of irregularity varies from $\pm$ 3.57 in March to $\pm$10.43 in October, which is occasioned by differences in price movement in particular years. The

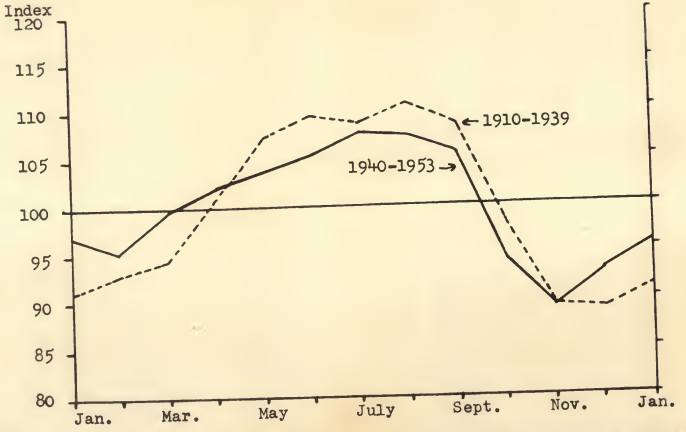

Fig. 4. Sorghum grain: Index of seasonal variation, mid-month average prices received by Kansas farmers, 1910-1939 and 1940-1953.

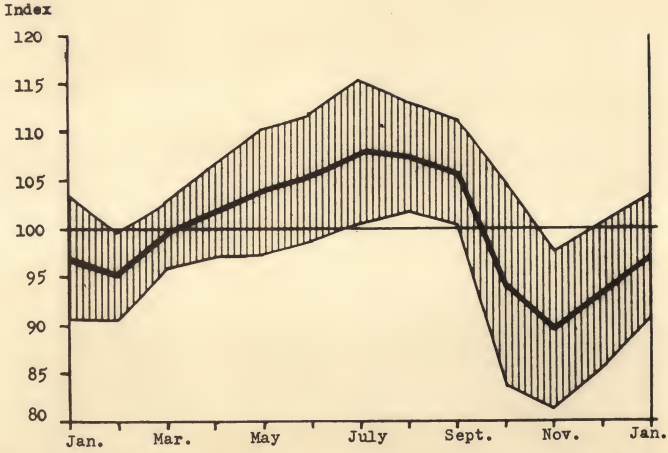

Fig. 5. Sorghum grain: Index of seasonal variation and index of irregularity, mid-month average prices received by Kansas farmers, 1940-1953.

range of the index of seasonal variation from 89.59 in November to 107.75 in July is fairly great, and the index of irregularity does not include 100, the baseline for November, February, July, August, and September.

The ratio of the range in the index of seasonal variation to the average index of irregularity is 2.8 for this series. This is considered moderate in size, and indicates a fairly strong seasonal movement.

Prices Usually Rise After Harvest. During crop years 1910 through 1953 prices have increased from November to July 30 times, remained unchanged once, and decreased thirteen times. In 27 years, the prices increased more than 15 cents per hundredweight. Table 4 is a consolidation of price changes from November to January, November to April, November to July, and November to November for the period 1910 through 1953, and 1940 through 1953, calculated from midmonth prices received by Kansas farmers.

Over the period 1910 to 1953, prices moved upward from November to January by 15 cents or more only about 25 percent of the time. About 50 percent of the time a price increase of over 15 cents was made from November to April; and from November to July, an increase of 15 cents per hundredweight or more was made in 60 percent of the years, and over 20 cents a little over 50 percent of the time. The number of times and the amounts prices decreased is also shown for the period. Year to year changes, November to November, for this era were evenly distributed between increases and decreases.

Table 4. Number of years midmonth prices received by Kansas farmers changed from November to January, April, July, and November, 1910-1953 and 1940-1953.

Change in price per cwt. received by farmers	Crop years 1910-1953 November to				Crop years 1940-1953 November to			
	January	April	July	November	January	April	July	November
	(Number of years)				(Number of years)			
Increases of:								
Over $1.00		2	3	2			2	1
.50 to 1.00	1	2	5	8	1	2	3	3
.40 to .49	2	4	1	2	1	2	1	1
.30 to .39	2	4	7	1	1	2	2	
.20 to .29	2	3	7	2	1	1	1	2
.15 to .19	3	7	4	2	2	2	2	2
.10 to .14	6	4		2	3	2		
.05 to .09	7	3	3	2	2	2		1
.01 to .04	4	2					1	
No change	4	1	1	2	1			
Decreases of:								
.01 to .04	2		4	1	1			
.05 to .09	4	3	2	2				
.10 to .14	2	4		1				
.15 to .19	1	1	2	2				
.20 to .29	2	1	1	3	1			
.30 to .39		1	2	2		1	1	
.40 to .49		1	1	3				
.50 to 1.00	1	1	1	5			1	3
Over $1.00	1			2				1

Source: Computed from Federal-State Crop Reporting Service data.

The period 1940-1953, 14 crop years, prices have increased more than 20 cents over 60 percent of the time from November to July. Prices advanced at least 5 cents 93 percent of the time from November to April and over 15 cents 60 percent of the time. November to January price changes tended to be of smaller magnitude, as price changes of 5 to 19 cents occurred one-half of the time. The period is dominated by a tendency for prices to rise from year to year as is illustrated by the November to November changes where increases of more than 15 cents occurred in about 60 percent of the years. Figure 6 illustrates the change in prices received by Kansas farmers from November to subsequent months during the period 1940-1953. The shaded area includes one-half of the dots and indicates the direction prices tended to move during that period. The seasonal for this period is shown in Fig. 5

An effect of the government loan program is depicted in Fig. 6. The price support program has tended to act as the floor, and prices have tended to rise from November to subsequent months a large majority of the time during the period 1940 through 1953. The extent and direction of change is shown by the shaded area which includes one-half of the price changes.

Monthly Price Changes. Month to month changes in Kansas farm price of sorghum grain for the period 1910-1953 is given in Fig. 7. One-half the dots are in the shaded area which shows the direction prices have tended to move from month to month. Price movements greater than can be depicted on the

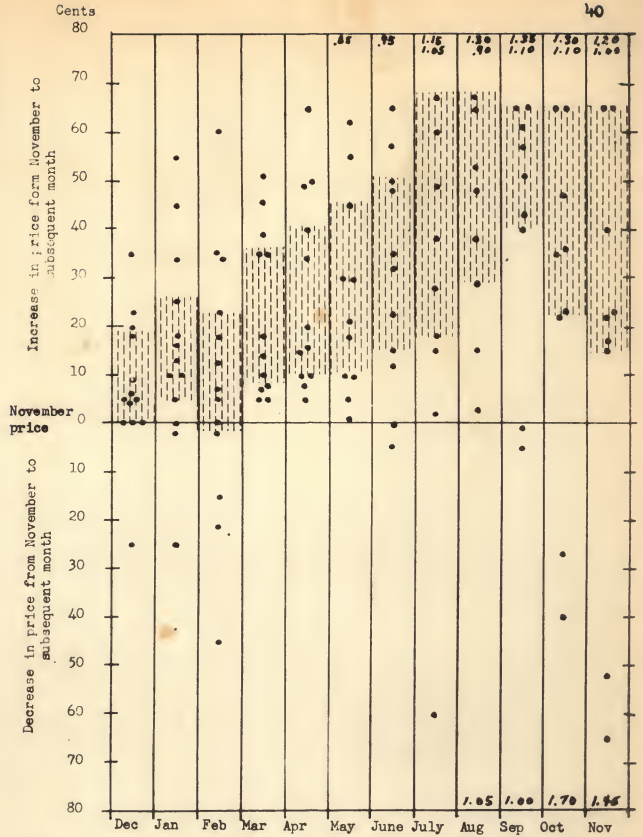

Fig. 6. Sorghum grain: Mid-month prices received by Kansas farmers. Change in price from November to subsequent months, 1940-1953.

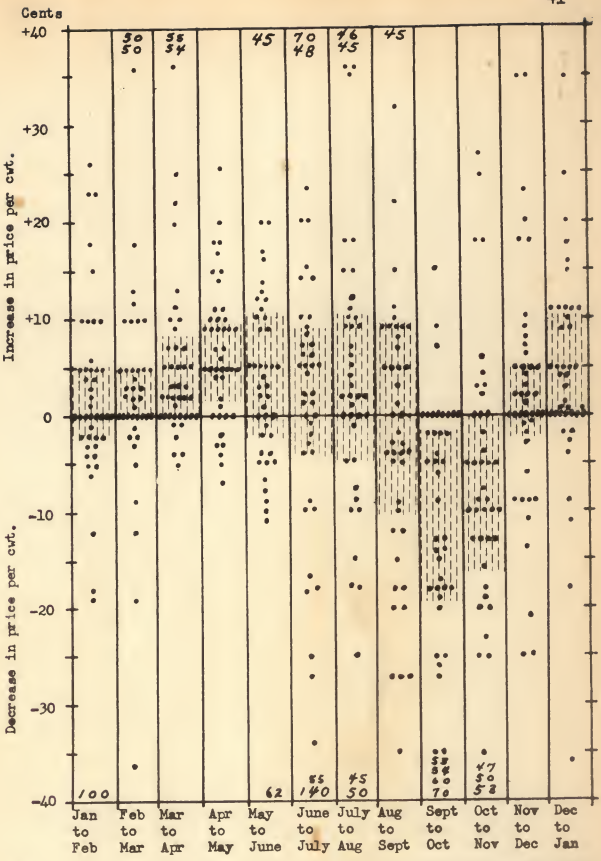

Fig. 7. Sorghum grain: Monthly change in Kansas farm price, 1910-1953. Each dot represents one year.

the scale selected are written in as cents per hundredweight. Prices have had the greatest tendency to go down from September to October and from October to November. A tendency for prices to move upward month by month from November to August can be seen. This would be expected upon examination of the seasonal. Great variability of prices is evident and the large price changes that have occurred from one month to the next, point to the risk involved in holding sorghum grain.

Price Changes from a Base Month to Subsequent Months. Percent of times midmonth prices received by Kansas farmers have gone up, down, or remained the same from a base month to subsequent months during the period 1940 to 1953 is given in Tables 5, 6, and 7. The tables are useful in deciding when to sell a crop. Table 5 shows for example, during the period 1940-1953 prices were higher in the months of March, April and May every year than the price in November, but prices were never higher in October than in September during this period. These tables, used in conjunction with the other illustrations in this section give a rather complete description of how Kansas farm price of sorghum grain has moved during recent years.

Some Effects of Government Price Supports

Price support programs have been conducted by the Federal government since 1940. Grain sorghum has been classed as a non-mandatory support commodity. The Secretary of Agriculture

Table 5. Grain sorghum, midmonth average prices received by Kansas farmers, percent of times price went up from base month to subsequent month, 1940-1953.

Base month	Subsequent month																						
	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
January	43	69	69	77	85	85	85	69	62	62	62	57											
February		77	92	85	92	85	77	69	54	62	62	62	62										
March			69	69	77	77	69	62	54	62	62	62	62	67									
April				69	77	69	69	69	54	54	54	62	62	67	67								
May					69	77	77	54	54	54	54	62	54	67	67	75							
June						77	69	62	46	46	54	62	54	67	67	75	75						
July							54	46	23	31	46	38	38	50	50	58	58	50					
August								46	15	15	15	38	38	50	50	58	58	58	58				
September									0	8	15	38	31	33	33	42	58	67	75	75			
October										23	46	69	54	67	75	67	92	92	92	83	67		
November											69	77	62	100	100	100	83	92	92	75	75	75	
December												69	62	83	83	83	83	83	83	75	67	67	67

Source: Computed from Federal-State Crop Reporting Service data.

Table 6. Grain sorghum, midmonth average prices received by Kansas farmers, percent of times there was no change in price from base month to subsequent month, 1940-1953.

Base month	Subsequent month																							
	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
January	21	0	15	8	0	0	0	8	0	0	0	0												
February		15	0	8	0	0	8	0	0	0	0	0	0											
March			15	15	0	0	0	8	0	0	0	0	0	0										
April				0	0	8	0	0	0	8	0	0	0	0	0									
May					0	0	0	0	0	0	0	0	0	0	0	0								
June						8	15	8	8	8	0	0	0	0	0	0	0							
July							15	0	0	0	0	15	0	0	0	0	8	8						
August								8	8	8	8	8	0	0	0	0	8	8	8					
September									23	8	8	0	0	0	0	8	8	8	0	0				
October										23	15	0	8	8	8	17	0	0	0	0	0			
November											23	8	8	0	0	0	8	0	0	0	0	0		
December												15	8	0	0	0	0	0	0	0	0	0	0	

Source: Computed from Federal-State Crop Reporting Service data.

Table 7. Grain sorghum, midmonth average prices received by Kansas farmers, percent of times price went down from base month to subsequent month, 1940-1953.

Base month	Subsequent month																						
	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
January	36	31	15	15	15	15	15	23	38	38	38	43											
February		8	8	8	8	15	15	31	46	38	38	38	38										
March			15	15	23	23	31	31	46	38	38	38	38	33									
April				31	23	23	31	31	46	38	46	38	38	33	33								
May					31	23	23	46	46	46	46	38	46	33	33	25							
June						15	15	31	46	46	46	38	46	33	33	25	25						
July							31	54	77	69	54	46	62	50	50	42	33	42					
August								46	77	77	77	54	62	50	50	42	33	42	42				
September									77	85	77	62	69	67	67	50	33	25	25	25			
October										54	38	31	38	25	17	17	8	8	8	17	33		
November											8	15	31	0	0	0	8	8	8	25	25	25	
December												15	31	17	17	17	17	17	17	25	33	33	33

Source: Computed from Federal-State Crop Reporting Service data.

is directed to consider these eight important factors before undertaking a non-mandatory price support program.[1]

1. The supply of the commodity in relation to the demand therefore.
2. The price levels at which other commodities are being supported and, in the case of feed grain, the feed values of such grains in relation to corn.
3. The availability of funds.
4. The perishability of the commodity.
5. The importance of the commodity to agriculture and the national economy.
6. The ability to dispose of stocks acquired through a price support operation.
7. The need for offsetting temporary losses of export markets.
8. The ability and willingness of producers to keep supplies in line with demand.

Figure 8 shows the relationship between Kansas farm price, United States parity price and the United States farm loan rate per hundredweight of sorghum grain. The loan rate has not set the ceiling price, but has tended to act as the floor for farm prices received. Since 1948, Kansas farm price of sorghum grain has not been above the United States parity price. However, during part of the Second World War, Kansas farm prices received were much above parity.

Kansas farm prices tend to move with the farm loan rate, but do not follow it closely. The variation in prices would undoubtedly have been even more extreme if a loan rate had not been in effect.

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[1] Price Support Handbook, United States Department of Agriculture, Production and Marketing Administration, (pamphlet) November 1952, p. 8.

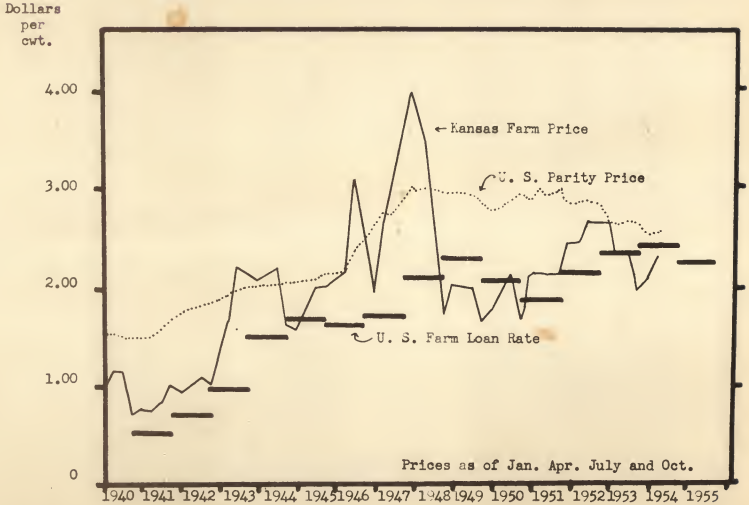
Dollars per cwt.
4.00
3.00
2.00
1.00
0
← Kansas Farm Price
U. S. Parity Price
U. S. Farm Loan Rate
Prices as of Jan. Apr. July and Oct.
1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955

Fig. 8. Sorghum grain: United States national average farm loan rate per hundredweight, United States parity price, and average price received by Kansas farmers in January, April, July, and October, 1940-1954.

It can be seen in Fig. 8 that the farm loan rate has not been a fixed percentage of parity. Parity prices of grain sorghums through December 1949 are based on the average price received by farmers for sorghum grains during August 1909 through July 1914 ($1.21 per 100 pounds) and the index of prices paid by farmers, including interest and taxes, as revised in January 1950. Transitional parity prices, 1950, 95 percent; 1951, 90 percent; 1952, 85 percent; 1953, 80 percent; and 1954, 75 percent of parity are computed by the formula in use prior to January 1, 1950.

Table 8 gives the farm loan rates since the grain sorghum support program began in 1940. The corn loan rate per bushel and the grain sorghum loan rate converted to a per bushel basis were used to compute the percent the grain sorghum loan rate has been of the corn loan rate given in the table.

If grain sorghum is considered to be worth at least 90 percent as much as corn for feeding the major classes of livestock, grain sorghums have been supported below their relative feeding value to corn, except in four years, 1943, 1944, 1945, and 1948. This has probably been at least partially responsible for the small carry-over of sorghum grain from year to year.

Kansas City Monthly Receipts and Shipments of Sorghum Grain

A summary of the monthly receipts and shipments of sorghum grain at Kansas City for the years 1950 through 1954 is given in Table 9. Average monthly receipts have varied more in amount

Table 8. Farm loan rates, corn and grain sorghum, United States, 1940-1954.

Year	Corn loan rate per bushel	Grain sorghum loan rate per hundredweight	Grain sorghum loan rate per bushel	Percent of corn loan rate
1940	.61	.54	.30	50
1941	.75	.71	.40	53
1942	.83	.98	.55	66
1943	.90	1.52	.85	95
1944	.98	1.70	.95	97
1945	1.01	1.65	.92	92
1946	1.15	1.72	.96	84
1947	1.37	2.12	1.19	87
1948	1.44	2.31	1.29	90
1949	1.40	2.09	1.17	84
1950	1.47	1.87	1.05	71
1951	1.57	2.17	1.22	77
1952	1.60	2.38	1.33	83
1953	1.60	2.43	1.36	85
1954	1.62	2.28	1.28	79

Source: Computed from United States Department of Agriculture data.

Table 9. Sorghum grain: Average monthly receipts and shipments, Kansas City, 1950-1954.

Month	Receipts		Shipments	
	Bushels	Percent	Bushels	Percent
January	1,231,680	9.7	827,280	8.1
February	663,450	5.2	947,580	9.3
March	1,126,620	8.9	856,430	8.4
April	857,420	6.8	868,550	8.5
May	685,860	5.4	1,161,950	11.4
June	535,630	4.2	1,050,170	10.3
July	183,600	1.5	786,150	7.7
August	222,600	1.75	616,330	6.1
September	234,080	1.8	426,930	4.2
October	1,011,440	7.95	751,610	7.4
November	4,010,700	31.6	981,000	9.7
December	1,933,080	15.2	885,770	8.7
Total	12,696,170	100.0	10,159,750	100.0

Source: Computed from data in the Kansas City Board of Trade Annual Statistical Reports, 1950-1954.

than have the quantities shipped from Kansas City. Storage tends to equalize the distribution of the grain throughout the year, and it is a function of a marketing system.

During the five year period studied, 31.6 percent of the average annual receipts reached Kansas City in November. This is a consequence of the practice of farmers marketing large amounts soon after harvest, which country elevators in turn ship to central markets for storage and distribution. It is interesting that over 60 percent of average annual receipts in Kansas City have occurred within a four month period, November, December, January and February. This period is the period of heavy farm marketings and it is a period of low seasonal prices.

The greatest quantity of shipments from Kansas City have occurred during months of May and June, but shipments have been fairly evenly distributed throughout the year. The period of highest seasonal prices received by farmers is the period the greatest quantity of grain is shipped from Kansas City.

Receipts of grain sorghums in Kansas City have been quite variable from month to month and year to year. The large amount of variation in quantities reaching Kansas City market varied directly with the size of crop, which directly influenced the quantity that could be or was sold from farms where grown. The relationship that has existed between production and quantities sold was shown in a previous section.

Futures Trading in Grain Sorghums

Kansas City has the distinction of being the first market in the world to trade in grain sorghums for future delivery.

Futures trading in grain sorghums on the Kansas City Board of Trade was begun on September 19, 1944. Preliminary proposals made on September 6, 1954, were submitted for a vote of the Board of Trade members September 18, 1954. On September 18, a vote by the members adopted the rules concerning trading in grain sorghums for future delivery, and for trading to begin on September 19, 1944. Rules adopted concerned contract grades of grain sorghum, deliveries on future contracts, the units of trading, commission charges, margins, ceilings, limits of price fluctuations and months.[1]

The futures market helps set the price pattern for dealing in spot supplies for forward shipment from the country, and affords hedging facilities for producers and handlers to minimize price risks.

Relationship between Kansas City Futures and Kansas Farm Price. A comparison of the current midmonth high price of grain sorghum per hundredweight on the Kansas City futures market with the midmonth prices per hundredweight by Kansas farmers is shown in Fig. 9. The period September 1944 through December 1954 provided 75 observations. There were no usuable quotations

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[1] Kansas City Grain Market Review, September 6, 1944 and September 18, 1954, Vol. 26, No. 75 and 85.

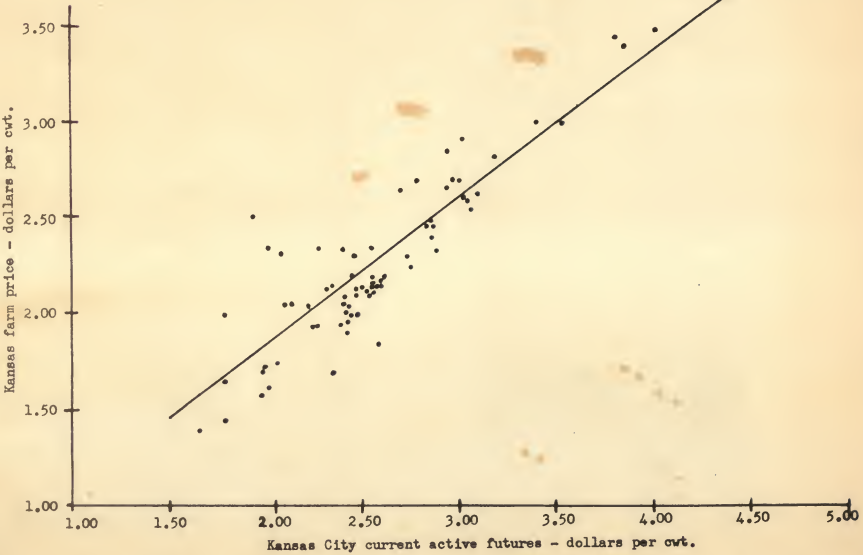

Fig. 9. Sorghum grain: Relationship between Kansas City mid-month high current active futures and the mid-month prices received by Kansas farmers, 1944-1954.

for the futures market in 49 months of this period. The comparison disclosed a close positive relationship. The coefficient of correlation was found to be 0.9042 and is beyond the one percent level of significance.[1]

A linear least squares regression line was computed and is drawn through the data in Fig. 9. The formula $Y = 2.2813 + .7729(X-2.5856)$ expresses the relationship.

The current active futures price tends to be above the Kansas farm price and by a larger absolute amount as the price of sorghum grain increases.

Volume of Trading. The grain sorghum futures market is still in its youth and has been affected by many factors. The relationship between current active futures and Kansas farm price prompted an inquiry as to what has been the relative volume of trading that has occurred in grain sorghum futures in years past and whether the trading has become more or less active since it began in 1944.

The volume of trading in grain sorghum futures has in general been quite small on the Kansas City Board of Trade with 1951 and 1952 having the greatest amount of trading activity. There was no trading in grain sorghum futures from 1949 until December 1950 in Kansas City, and only a small amount in 1953 and 1954.

Table 10 is the average daily open interests in grain sorghum futures on the Kansas City Board of Trade by month from 1944 to 1954. Open interest is the amount of grain sorghum

[1] George W. Snedecor, Statistical Methods, Fourth Edition, p. 149.

Table 10. Grain sorghum futures: Average daily open interests by month in Kansas City, 1944-54.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
						(Thousands)						
1944	--	--	--	--	--	--	--	--	2,870	13,686	410	886
1945	870	732	666	730	619	509	503	170	261	356	487	453
1946	259	241	207	221	217	49	--	--	--	35	71	72
1947	96	92	53	101	108	326	342	110	46	--	11	55
1948	36	30	20	--	21	--	--	--	--	--	--	--
1949	--	--	--	--	--	--	--	--	--	--	--	--
1950	--	--	--	--	--	--	--	--	--	--	--	402
1951	1,349	3,535	4,778	5,599	4,987	4,915	3,400	3,152	2,327	3,208	8,699	14,415
1952	16,352	15,633	11,632	11,521	7,666	5,583	1,580	2295	232.5	175	118	3
1953	--	--	--	--	--	--	--	21	55	170	266	8
1954	--	--	--	--	1	25	17	11	--	26	168	406

Source: Computed from data copied from The Kansas City Grain Market Review, 1944 through 1954.

which traders would be required to deliver to satisfy unfilled contracts if there were no further trading and the futures contracts were closed out by the actual delivery of the grain on a particular day. The figures in Table 10 represent an average of open interest in Kansas City grain sorghum futures by deliveries on the last trading day of each week in a month, and are not an average of the open interest of each day in the month.

Grain Sorghum Marketed Through Livestock

Malcolm Clough and James W. Browning begin their section on Feed Grains in Marketing, Yearbook of Agriculture, 1954, as follows:

> Feed grains are marketed principally through livestock and livestock products. The cash sales of the four feed grains, corn, oats, barley, and the sorghum grains--are comparatively small; they make up only five percent of the gross income of farmers, but cash receipts from the livestock and poultry that are produced from the feed grains and forages account for more than 50 percent of the total farm income.
>
> The surplus feed-grain producing area of the Midwest has become the center of the livestock industry, particularly hogs and beef, which can be processed and shipped to major consuming areas more economically than feed grains.[1]

The Kansas grain sorghum crop has been marketed largely as a cash grain. The question, can Kansas farmers profitably market grain sorghum through livestock, seems to be one of great

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[1] Marketing, Yearbook of Agriculture, 1954, United States Department of Agriculture, p. 403.

importance. In the first place, considering the long-range welfare of Kansas agriculture, cash crop production is considered by some persons, to deplete soil fertility, and as a contributor to serious soil erosion. Diversification tends to stabilize farmers' incomes and also enables the farmer to better utilize his labor throughout the year. If a farmer raises a crop of grain sorghum, he must decide whether to market the grain sorghum as a cash grain, store and sell at a later date, or feed and market in the form of livestock. Observation of available data indicates that in the past, the major part of grain sorghum in a big production year was not only marketed as a cash crop, but it was also marketed soon after harvest, or with only short periods of storage on farms.

Consumption Trends: Population growth will tend to increase the demand for meat and meat products and there has also been a tendency for the consumption of meat and meat products to increase relative to the consumption for cereal grains, as real income increases in the United States.

Studies of the possible long range prospects for agriculture have been made by the United States Department of Agriculture. In a mimeographed report entitled Long Range Prospects for Agriculture, prepared by Rex F. Daly, Glenn T. Barton, and other research workers in the United States Department of Agriculture, it was attempted to develop future demand and supply prospects under a logical set of assumptions centered at about 1975. A few portions of this report as pertaining to possible production-adjustments that will have implications

in the marketing of grain sorghums through livestock are quoted below:

> Rising incomes are expected to increase per capita demand for meat and poultry to levels perhaps a sixth above the 1951-53 average.[1]
>
> Requirements for meat animals and poultry would increase by more than 50 percent with largest relative gains for beef. Use of feed would rise with the increase in demand for livestock products and the need for some protein feeds may rise more than population.[2]
>
> The greatest increase needed in crop production would be in the feed crops--feed grains, hay, pasture, and soybeans (our chief source of protein feed). Crops for which little or no increase in production would be needed include the major food grains. Potatoes and cotton are examples of crops whose production would need to be increased less percentage wise than the projected increase in population.[3]

Even though almost every action taken by an individual, a firm or the government for a commitment which will extend over several years has involved some type of an appraisal of the future, the future cannot be definitely predicted, since many forces, economic or otherwise, can alter expected developments.

Comparison of Kansas and Iowa Livestock Feeding Ratios

A comparison of feeding ratios that have existed in Kansas and in Iowa, a Corn Belt state, is presented in

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[1] Long Range Prospects for Agriculture, United States Department of Agriculture, (Mimeograph report), June 6, 1955, p. 3.

[2] Ibid., p. 3.

[3] Ibid., p. 4.

Fig. 10 and Fig. 11. This comparison was made to see if Kansas farmers feeding grain sorghum to beef and swine would have had as favorable a feeding ratio as that faced by Iowa farmers feeding corn during the same period. The comparison was based upon average monthly prices received by farmers in these states for the products, corn, grain sorghum, beef, and hogs.

The Iowa corn-hog ratio expresses the number of bushels of corn equal in value to 100 pounds of pork in Iowa. Similarly, the computed corn-beef ratio is the number of bushels of corn equal in value to 100 pounds of beef in Iowa.

The Kansas grain sorghum-hog ratio is an expression of the number of bushels of grain sorghum that is equal in value to 100 pounds of pork, considering grain sorghum to be worth only 90 percent as much as corn in fattening hogs. The Kansas grain sorghum-beef ratio was computed on the basis that grain sorghum was worth 92 percent as much as corn in fattening beef cattle, and the ratio expresses the number of bushels of grain sorghum that was of equal value to 100 pounds of beef in Kansas.[1]

Kansas Grain Sorghum-Beef Ratio Compared with Iowa Corn-Beef Ratio. Referring to Fig. 10, it is seen that Iowa farmers have had a relative advantage in feeding ratio for beef cattle from May 1952. There are two factors that are important to keep in mind in interpreting Fig. 10. First, the data on beef

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[1] The relative feeding value of grain sorghum to corn used were those given in Table 2 of Kansas Agricultural Experiment Station Circular Number 299.

Fig. 10. Beef feeding ratios: Number of bushels of grain equal in value to 100 pounds of beef (live weight). Based on mid-month prices received by farmers in Kansas and Iowa, 1951-1955.

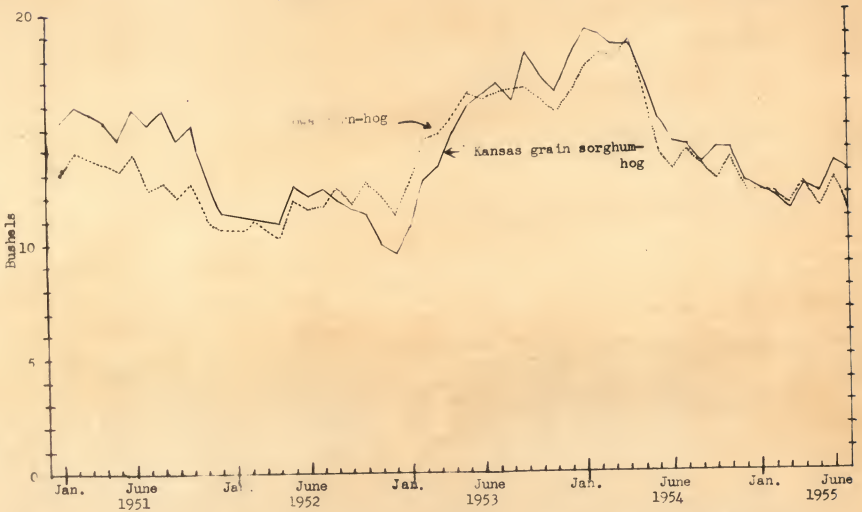

Fig. 11. Hog feeding ratios: Number of bushels of grain equal in value to 100 pounds of hogs (live weight). Based on mid-month prices received by farmers in Kansas and Iowa, 1951-1955.

cattle prices received by Iowa and Kansas farmers, respectively, may not be entirely comparable, as the average prices received by Iowa farmers for beef were higher continuously since March of 1952. Kansas farm prices received for 100 pounds of beef tended to be low relative to Iowa prices during the period of July to December of each year, and the spread tended to be narrow during the months of February and March. This phenomena is probably best explained by the relative quality and degree of finish of the cattle marketed by farmers in the two states because of differences in feeding programs. It is believed that most grain fed cattle in Kansas were marketed during the months of January, February, March and April.

The second limitation is that the comparison cannot indicate whether or not it is more profitable to market grain sorghum through beef or as a cash crop, as this depends on the prices paid for the cattle, amount of gain in feedlot, efficiency of gain, and final selling price of the cattle.

The comparison only points out, subject to the above limitations, that although Kansas farmers have generally received a low price for their grain sorghum relative to the price of corn, the Kansas grain sorghum-beef ratio has not been as favorable as the corn-beef ratio which has existed for the Iowa farmer since May of 1952. The ratio has fallen in both states, indicating that beef cattle prices have fallen relative to prices of corn and grain sorghum since 1951.

Iowa Hog-Corn and Kansas Grain Sorghum-Hog Feeding Ratios. Much corn grown on farms in Iowa has been fed to swine. Most Kansas grown sorghum grain has been sold from producing farms as a cash crop. A comparison of the grain-hog ratios was made to determine if there was an advantage in feeding corn to hogs in Iowa, a Corn Belt state, as compared with feeding grain sorghum to swine in Kansas. Figure 11 illustrates the relationship existing since 1951. It can be seen that the Kansas grain sorghum-hog ratio, which was computed on the basis of grain sorghum being worth only 90 percent as much as corn for feeding hogs, has been higher than the Iowa corn-hog ratio about 75 percent of the time.

Therefore, if it has been profitable to feed corn to hogs in Iowa, it also should have been as profitable to feed grain sorghum to hogs in Kansas. Physical facilities on Iowa farms, relative ease of storage of the grains, and year to year stability of production are factors which probably account for a larger feeding program in Iowa, even though Kansas farmers have had as favorable a feeding ratio.

This comparison does point to the need for a method by which a farmer can determine when grain should be fed to livestock and when it can be more profitably sold as a cash crop.

SUMMARY AND CONCLUSIONS

Grain sorghums have tended to increase in importance both in the United States and in Kansas since 1930. Discovery of a male sterility factor has provided plant breeders with what is now believed to be a practical method of hybrid development. Hybrid sorghums are expected to have advantages about parallel to those of hybrid corn. Further increases in production of grain sorghum in Kansas should be realized. Grain sorghums are likely to be grown on acres taken out of wheat production by allotment programs in Kansas. Development of higher yielding sorghum hybrids will probably widen their production area in the United States.

The quantity of sorghum grain sold from farms where grown in Kansas has varied directly with production. For the period 1929 to 1953 inclusive, the average quantity of sorghum grain produced in the state was 19,178,880 bushels, and the average quantity sold from farms where grown was 9,071,720 bushels or about 47 percent of production. Average production in Kansas for the period 1949 to 1953 was 34,997,200 bushels and 63.8 percent was sold off of farms where grown during this period. This indicates a fairly fixed utilization figure on grain sorghum producing farms.

Size of crop has had little effect on the percentage distribution of grain sorghum sales throughout the year. The sale of sorghum grain by farmers is largely concentrated in a four month period, October, November, December, and January.

Combine harvesting is believed to have influenced the monthly pattern of marketings by farmers.

The practice of farmers marketing their grain in greatest amounts during the harvest season when prices are at the seasonal low gives support to the idea that Kansas farmers have not obtained maximum return from their grain sorghum production; however, consideration of the difficulties of storage, the costs of storage, and of price variation make it necessary to stress the element of risk involved in holding grain. The pattern of seasonal price movements have been irregular, therefore, decisions by the farmers to store must be made for each individual year and for the peculiar condition of the lot to be stored with consideration of costs and availability of storage space. During the period 1940 to 1953, it has been a fairly good risk to store, as prices advanced at least 5 cents per hundredweight from November to July 93 percent of the time and at least 30 cents per hundredweight over 50 percent of the time for this period. Based on costs of storing wheat, a price gain of 30 cents should more than cover costs of storing 100 pounds of sorghum grain on most farms.

If a farmer has adequate storage space available and can harvest the grain in condition for storage, price expectations and variable costs of storage, rather than total costs of storage will be most influential in his deciding when to sell, in the short run period.

The pattern of marketing by farmers and country elevators in Kansas indicates that farmers, especially in the western one-third of Kansas have used country elevators mainly as a cash outlet for their sorghum grain production. Since the country elevators in this area sold only small quantities of the grain back to other farmers in the local area, farm livestock enterprises were evidently on insufficient scale in this area to utilize all the grain produced in the area as feed.

It will be generally agreed that transportation costs plus handling charges will make the grain a more expensive feed when purchased by farmers in other areas, than to those farmers in the local area in which the grain is produced. Therefore, if other feeds necessary to make a livestock feeding program possible can be grown, an adjustment toward greater livestock production should be advantageous. Lower transportation costs on a relatively less bulky product, cattle, sheep or hogs, as compared with sorghum grain, would also tend to make a feeding program profitable for a grain producing area. It is realized that the variability in production from year to year would require storage of feed reserves to insure farmers an adequate feed supply and that the costs and difficulties of holding or storage might make this prohibitive.

The following quotation is considered apt at this point:

> The effect of a sorghum-feeding program would be to aid the wheat country, but probably at the expense of some other areas such as the rich corn-producing regions. The outcome of such a program depends upon

how important livestock products will be in the diet of the future. If the demand goes to new highs because of a generally higher standard of living and an increased population, then we shall need more livestock than our present ranges can provide. In that case, the Wheat Belt, with the aid of sorghums, might produce the extra animals. Less emphasis would then be placed on so much cash-crop farming in some areas and more emphasis would be given to the production of livestock. The shift is usually a desirable one in any agricultural economy, but it takes away the possibility of making huge profits in any one year.[1]

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[1] Haystead, Ladd, and Gilbert C. Fite, The Agricultural Regions of the United States, p. 199.

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The valuable assistance and suggestions given by the major instructor, Dr. Leonard W. Schruben, Professor, Agricultural Economics, Kansas State College, in the preparation of this thesis is gratefully acknowledged.

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MARKETING GRAIN SORGHUM IN KANSAS

by

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AN ABSTRACT OF A THESIS

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Grain sorghums are adapted and can be grown on most soils in Kansas. Although the production of sorghum grain has been small compared with production of wheat, it has been about equal to corn production in Kansas. Grain sorghum is also an important crop from the standpoint of its ability to resist drought and in its being adapted to the western two-thirds of Kansas where it has a comparative advantage over corn.

Combine types of grain sorghum, which became widely distributed in the state after 1935, have largely replaced the earlier types which were originally introduced into the United States from British South Africa in the 19th century.

Texas, Kansas, and Oklahoma, in that order, have been leading states in the production of grain sorghum and together produced 83 percent of United States production in 1953 and 1954. Texas alone produced about 50 percent of total production and Kansas produced an average of 24 percent of United States production in these two years. Average production in Kansas in 1953 and 1954 was 37,839,000 bushels.

Kansas farmers have not obtained maximum return from their sorghum grain production. It is believed that more complete knowledge on marketing of the commodity can lead to improvements. In this study emphasis was given to those prices of sorghum grain and to those marketing practices important in influencing entrepreneural decisions involved in the marketing of the crop.

There is considerable parallelism in the marketing of farm products that have similar characteristics. For the most part, grain marketing facilities in Kansas have been developed chiefly to move wheat from farm to market. Although the production of sorghum grain is not as important as that of wheat in Kansas if viewed from the quantity of grain produced, it is important from the standpoint that it is an alternative crop adapted in the state, and for the present at least, has no physical surplus problem.

To the extent that inefficiencies exist in the marketing system, or knowledge of the market is lacking, the incomes of those farmers who produce the grain and of those persons who handle or utilize the grain are affected.

Marketing practices and sorghum grain movements were analyzed by both the commodity and functional approach of market analysis. Factors that cause or explain variation of prices in time and between commodities have been studied by statistical measures. Historical data was used extensively in this study.

No assurance can be given that past price relationships, price movements, or marketing practices that are projected into the future will occur again. Also, this study is specifically limited to certain aspects of marketing of grain sorghum as the problem is complex.

Grain sorghum production has been greatest in the western two-thirds of Kansas. Total production by crop reporting

district has varied from year to year both in amount produced and in percentage of the state's production. Crop reporting district 7, southwestern Kansas, produced 30 percent of the state's production from 1949-1953. Fifty-two percent of Kansas grain sorghum production was concentrated in the western one-third of Kansas and only about 13 percent in the eastern one-third during this five year period.

Kansas production has tended to increase in the last 25 years as has United States production. Production has tended to increase more than harvested acres, indicating a tendency for higher yields per acre. Discovery of a male sterility factor has provided plant breeders with what is now believed to be a practical method of hybrid development. Further increases in grain sorghum production in Kansas should be forthcoming, as hybrid sorghums are expected to have advantages about parallel to those of hybrid corn.

The quantity of grain sorghum sold from farms where grown in Kansas and Kansas production has been closely related, as the coefficient of correlation of 0.968 indicates a close positive relationship. In Kansas, a large crop has not only resulted in a larger absolute quantity of sorghum grain marketed, but has also resulted in a percentage increase of the portion of production sold from farms where grown. This indicates a relatively fixed utilization figure has existed on grain sorghum producing farms which has not increased proportionally with the size of crop. Size of crop has had

little effect on percentage distribution of grain sorghum sales by farmers throughout the year in Kansas. The sale of the grain has been largely concentrated in a four month period, October, November, December, and January. Combine harvesting is believed to have influenced the monthly pattern of marketings by farmers.

Country elevators are believed to have handled the majority of grain sorghums marketed by farmers. In the western one-third of Kansas, elevator managers interviewed reported very little grain sorghum as being resold to other farmers in the local area, so that the country elevator in this area has been used mainly as a cash outlet for sorghum grain production by the local farmer. Shipments of the grain from this area have been heavy, as elevators reported they have sometimes handled as much grain sorghum as wheat.

Some local receipts from farmers have been resold to other local farmers by country elevators in central and eastern Kansas. There has been a local demand for more grain sorghum than has been produced in eastern Kansas so that elevators here have shipped in grain sorghums, however, this has also depended on the price and quantity of corn available.

Farmers marketing the greatest amount of sorghum grain during the harvest season when prices are at the seasonal low seems to indicate they have not maximized their returns. However, consideration of the difficulties of storage, the costs of storage, and price variations make it necessary to stress the element of risk involved in storing grain for future sale.

In an effort to determine when to sell, based on past price movements, several techniques were employed. In general, the price data has been analyzed for two time periods, 1910-1939 and 1940-1953. The government price support program on grain sorghum began in 1940 so it was felt that this division would give the most meaningful analysis.

For the years 1940-1953, the seasonal low price tended to be in November and the seasonal high in July. The range of the index of seasonal variation is fairly great, a low of 89.59 in November and a high of 107.75 in July. The index of irregularity varies from ± 3.57 in March to ± 10.43 in October, which is occasioned by differences in price movements in particular years, and includes about 60 percent of the individual years in the series. The ratio of the range in the index of seasonal variation to the average index of irregularity is 2.8 for this series.

During the period 1940-1953, it has been a fairly good risk to store, as prices advanced at least 5 cents from November to July 93 percent of the time and at least 30 cents per hundredweight over 50 percent of the time for this period. Based on costs of storing wheat, a price gain of 30 cents should more than cover costs of storing 100 pounds of sorghum grain on most farms.

If a farmer has adequate storage space available and can harvest the grain in condition for storage, price expectations and variable costs of storage, rather than total costs of

storage will be most influential in his deciding when to sell in the short run period.

A comparison of the current midmonth high price of grain sorghum per hundredweight on the Kansas City futures market with the midmonth prices per hundredweight received by Kansas farmers from September 1944 to December 1954 disclosed a close positive relationship. The coefficient of correlation was found to be 0.9042 and is beyond the one percent level of significance. The current active futures price has tended to be above the Kansas farm price and by a larger absolute amount as the price of sorghum grain increases.

The problem of form in which to market grain sorghum is of importance. Observation of available data indicates that in general, farmers who have produced grain sorghums in Kansas, especially in the western one-third of the state, have sold their production as a cash crop, soon after harvest, and have not fed it to livestock in any great amounts. This is in contrast with the marketing of corn by farmers.

Comparison of the Iowa corn-beef ratio and the Kansas grain sorghum-beef ratio, subject to certain limitations, disclosed that since May of 1952, Kansas farmers have not been faced with as favorable a beef feeding ratio as the Iowa farmers. The ratio has fallen in both states, indicating that beef cattle prices have declined relative to prices of corn and grain sorghum since 1951.

The comparison of the Iowa corn-hog ratio and the Kansas grain sorghum-hog ratio indicated a more favorable feeding ratio

has existed about 75 percent of the time in Kansas as compared with Iowa since 1951. If it has been profitable to feed corn to hogs in Iowa, it should have been at least as profitable to feed grain sorghum to hogs in Kansas. This comparison points to the need for a method by which a farmer can determine when grain should be fed to livestock and when it can be more profitably marketed as a cash crop.

It will be generally agreed that transportation costs plus handling charges will make the grain a more expensive feed when purchased by farmers in other areas, than to those farmers in the local area in which the grain is produced. Therefore, if other feeds necessary to make a livestock feeding program possible can be grown, an adjustment toward greater livestock production should be advantageous. Lower transportation costs on a relatively less bulky product, cattle, sheep or hogs, as compared with sorghum grain, would also tend to make a feeding program profitable for a grain producing area. It is realized that the variability in production from year to year would require storage of feed reserves to insure farmers an adequate feed supply and that the costs and difficulties of storage might make this prohibitive.